

BUILDING PROBLEMS OF THE
BADGER BASKET COMPANY

BY

DERWOOD S. CHASE

ARMOUR INSTITUTE OF TECHNOLOGY

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Study of the building
problems of the Badger

STUDY OF THE BUILDING PROBLEMS OF
THE BADGER BASKET COMPANY,
OF BURLINGTON, WISCONSIN

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A THESIS

PRESENTED BY

DERWOOD S. CHASE

TO THE

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A STUDY OF THE BUILDING PROBLEMS OF THE BADGER
BASKET COMPANY, OF BURLINGTON, WISCONSIN.

Due to the recent period of high cost of labor and material, every effort has been made to increase the efficiency of manufacturing plants. The changes were easily recognized in some plants due to the poor system which had been used during the period of low cost of labor and materials, but in other plants, an extensive study of existing conditions had to be made.

The Badger Basket Company, Burlington, Wisconsin, was not an example of extreme neglect in regard to manufacturing cost, for it compares well with other plants in that part of the country. However, it was not perfect, and in the study made of it, the following are the outstanding changes which are recommended

from this investigation:

- (1) A change of power from steam to electricity.
- (2) An addition to be built on to the factory to relieve excess congestion during normal output periods.
- (3) A complete rearrangement of the path of completed product, from the raw material to the warehouse.
- (4) A study and change of the lighting system.

I. GENERAL CONDITIONS.

The factory consists of a two story building of dimensions approximately 40 x 100 feet containing nearly all of the machinery; and of a two story addition on the south of dimensions approximately 40 x 60 feet. The engine and boiler are located in a small building adjoining the south and east walls respectively of the two



sections mentioned above.

All of the machinery in the main building is driven by a simple slide valve engine which is belted to the main lineshaft extending north and south. From this line shaft, belts transmit the power direct to several machines nearby, and through jackshafts to the machines in the central and western part of the building.

Coal and logs are brought to the factory on a track between the Fox River and the west side of the building. The logs are cut into the required lengths with a drag or reciprocating saw, siaked in vats of hot water, cleared of bark and then made into veneer stock with the veneer lathe. The logs not suitable for veneer are cut into lumber or firewood and sold. All bark and wood refuse are burned in the boiler to generate steam.

II. PRESENT EQUIPMENT.

The power plant and factory are equipped with the following apparatus:

Power Plant.

(a) Boiler.

One (1) hand fired return tubular boiler rated at 65 horsepower (HP) and operating at 80 pounds pressure.

(b) Engine.

One (1) 13 x 15 - 195 R.P.M. - 100-120 horsepower (HP) Ames Iron Works simple slide valve engine, operating non-condensing.

(c) Pump.

One (1) 6" x 4" x 6" Prescott duplex boiler feed pump.

The boiler and engine have been in operation about eight years in the present plant.

Factory.

<u>M a c h i n e .</u>	<u>H. P. Required.</u>
1 - 90" Veneer lathe	40 to 60
1 - 52" Veneer lathe	20 to 35
1 - Gang saw	10 to 20
1 - 90" Clipper	5 to 6
1 - 52" Clipper	4
1 - 20" Surface Planer	5
1 - 14" Circular Saw	5
1 - Coiler	2
1 - Lapper	1
1 - 36" Band Saw	3
1 - 16" Cut-Off Saw	5
1 - 42" x 96" Tumbler	2
1 - 14" Circular Saw (second floor)	2 to 3
1 - 8" Surface Planer	3
1 - 22" Cut-Off Saw	7-1/2
1 - 36" Rip Saw	15
1 - Cross Cut or Drag Saw	7-1/2

Total maximum connected load 179-HI

III. PRESENT OPERATING CONDITIONS.

At present the power plant is operated by one man, who acts as both engineer and fireman. All exhaust steam is utilized for heating the building and log soaking vats. The fuel used makes it very difficult to maintain a steady steam pressure; and the load on the engine becomes so heavy at times that the speeds of the machines are reduced below economical limits.

Inasmuch as electric power in the plant has never been used, attention might be called to the advantages and flexibility of electric drive as compared with conditions now existing:

1. The entire veneer and stock manufacturing equipment are now dependant upon one unit for operating. If this unit fails, all operation

must stop until necessary repairs are made. With electric power, on the other hand, this equipment could be operated with several small motors, each of which would be independent of the other and trouble with one would not affect the operation of the others.

2. There are times when it is desirable to operate only a portion of the factory at a time. With the present method of drive the engine and entire line shaft, as well as several jackshafts, must be driven in order to carry any small load - a condition which gives poor economy of operation.

IV. HEATING REQUIREMENTS.

Steam.

The steam required for heating the buildings, dry kiln, vats and forms determines entirely the amount of fuel required. Live steam

is used for the dry kiln and forms as well as for the factory building and vats; while exhaust steam is used for the factory building and vats whenever it is available.

From the analysis made, the total steam required for various purposes is tabulated as follows:

Heating the factory	760,000 lbs./yr.
Heating of dry kiln	735,000 lbs./yr.
Heating of vats	3,070,000 lbs./yr.
Miscellaneous uses	<u>435,000</u> lbs./yr.
Total	5,000,000 lbs./yr.

Coal.

The data which was furnished shows that during 1915, 791,620 pounds of coal were purchased. The wood refuse fired has a fuel value equivalent to about 82,650 pounds of coal; therefore the total coal equivalent of all fuel fired is 874,270 pounds. With an estimated re-

quirement of about 5,000,000 pounds of steam, the evaporation rate of the boiler is 5.72 pounds of water per pound of coal fired. This figure appears to be very reasonable for the type and size of boiler, hence it can be assumed that the estimates for water and coal are very nearly correct.

The wood refuse used for fuel is only 9.45% of the total coal equivalent and coal to generate steam for heating purposes would have to be purchased even if the steam engine were not operated for power. But the engine is not able to carry it's load under the present system of operation; and it is therefore necessary to make some changes in order to improve conditions.

V. POWER REQUIREMENTS.

With 80 pounds steam pressure, the engine is able to deliver about 100 horsepower (HP) at

the pulley on the main line shaft. The total connected load of all the machinery is about 180-Hp; but, since all of the machines are not in use at the same time, the maximum power requirements will probably not exceed 125-Hp. Considerable power is lost in the line shaft, jack shafts and long belt drives; therefore, during the period of maximum load, the engine is required to deliver about 160-Hp at the main line shaft pulleys. At these periods the engine is forced to carry about 60% overload, and an inevitable decrease in speed is the result.

VI. EQUIPMENT CHANGES.

The two remedies for such an operating condition will now be considered in detail.

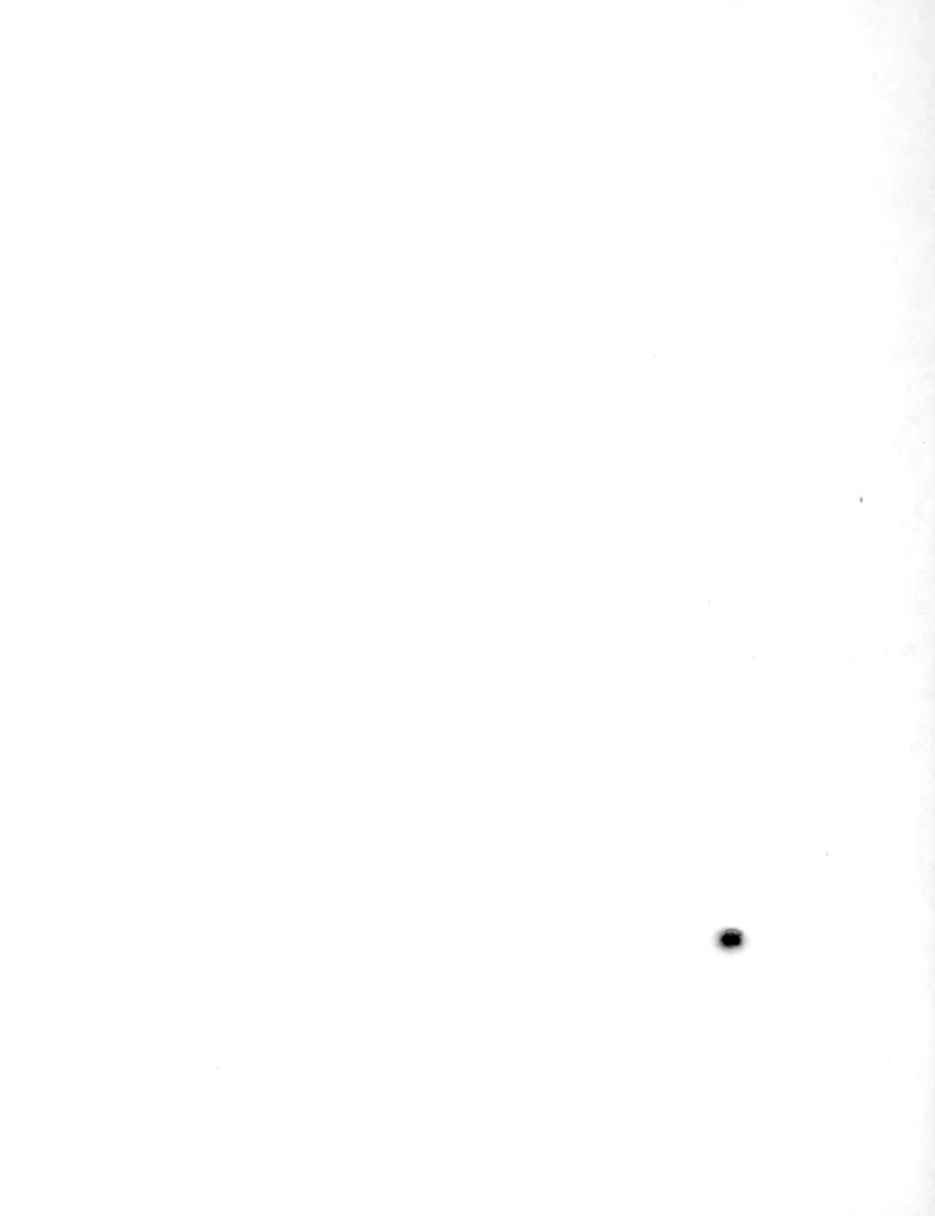
(1) To Increase Capacity of the Engine.

The only way of increasing the engine capacity, without purchasing an additional

unit, is to supply the engine now in use with steam at a pressure of about 110 pounds. The engine would then deliver about 135-Hp at the main lineshaft pulley and would probably maintain a more uniform speed than at the present time. But this increase in capacity is not sufficient for a demand of 160-Hp. Furthermore it will not increase the output of the plant when all of the machines are in operation at the same time. At such a time, it will be necessary to have a larger engine or else relieve the present engine of it's overload.

(2) To Relieve the Engine of It's Overload.

The most flexible, economical and least expensive way of relieving the engine of it's overload is to install electric motors. With motor drive, the friction losses in several sets of jack shafts and two long belt drives, can be eliminated and this will be noticed more when the machines in



the far end of the building are not in use. A more uniform speed can also be maintained and thereby increase the output of the machines and the entire factory.

Below is a list of motors which could be used together with the engine; and attached to this report a blue print showing the proposed layout for relieving the engine of it's overload.

Item 1. For, -

14" Gang Saw.

One (1) 15-HP 1800-RPM Squirrel cage motor.

Item 2. For,-

22" Cut-Off Saw.

36" Rip Saw.

One (1) 15-HP 1800-RPM Squirrel cage motor.

Item 3. For, -

14" Rip Saw.

8" Porter Planer.

Coiler.

One (1) 7-1/2-HP 1800-RPM Squirrel cage motor.

Item 4. For, -

18" Cut-Off Saw.

36" Band Saw.

Lapper.

Air Compressor.

42" x 96" Tumbler.

Saw Sharpeners.

One (1) 7-1/2-HP 1800-RPM Squirrel Cage Motor.

Cost of Changes and Equipment.

The cost of the changes and the equipment recommended above is as follows, according to quotations made in 1916:

2 - 15-HP 1800-RPM Motors at \$200.00..	\$400.00
2 - 7-1/2HP 1800-RPM Motors at \$130.00	\$260.00
Wiring and mounting of motors	\$225.00
Balancing-coil for lighting	\$15.00
Miscellaneous items	<u>\$50.00</u>
Total	\$950.00

The Motors quoted are new General Electric motors, three phase, 240 volt, 60 cycle. It might be possible to secure some second hand motors at a saving of about 10% or 15%. The estimates for wiring and for miscellaneous items are perhaps somewhat higher than what will be actually paid, therefore \$950.00 is about the maximum amount which will have to be spent to make the changes recommended.

VII. COST OF PURCHASED ELECTRIC SERVICE.

Rate Schedule.

The energy for the part of the load which is supposed to be driven with electric power will be charged for at an "Increment Rate". This rate provides for the following charges:

First 200 kilowatt hours (KWH) consumed during any month6 cents per KWH.

Next 200 KWH during any month ...8 cents/KWH.

Next 200 KWH during any month ...4 cents/KWH.

Next 1400 KWH during any month ..3 cents/KWH.

All energy in excess of 2,000 KWH during any month - 2 cents per KWH.

On bills paid at office of Company within ten days of bill, a discount of 5% of the first \$25.00 of all bills and 1% on amounts in excess of \$25.00 will be given.

The minimum monthly payment to be made shall be 75 cents per horsepower, or fraction thereof, nominal rated capacity.

Power consumed.

In making an estimate of the energy consumption it was difficult to arrive at very definite figures because of the lack of test data and the uncertainty as to the amount of material passed through the various machines. The kind of lumber used also has a bearing upon the energy consump-

tion; for certain kinds of lumber require a greater expenditure of energy than others. The best that could be done under these conditions was to assume average conditions during the "Approximate number of hours" each machine was on operation per day.

The estimated energy consumption for the load to be carried by the proposed electric motors is a proximately 30,000 to 33,000 kilowatt hours (KWH) per year or about 2,700 KWH per month - including the lighting. The cost of this energy would be about \$77.40 from the rates given above.

VIII. RECOMMENDATIONS.

The question of additional floor space can only be answered by the crowded conditions when running at full capacity. It is necessary to store the baskets in the factory proper during manufacturing since the operations in the

factory do not keep the basket in continuous motion. Due to this fact, all space between machines and benches becomes filled with partly built baskets and crowd the work to such an extent, that between each operation it is often necessary to move a pile of baskets several times. With the increased floor space, it would mean that a basket was moved but once in going from one operator to another, also with relieved conditions the workers are able to make more progress which increases the production and decreases the cost. With these factors in mind, it was decided that a 50 foot, two story addition should be made on the south side of the building. This change is indicated on the drawings attached at the end of this report.

PATH OF THE PRODUCT.

In the manufacture of baskets, the raw material cannot enter at one end and follow through the

factory, coming out as a completed product. The reason for this is that after certain operations it must be taken to a drier or drying shed and left for a given length of time, after which it continues through the factory. Under the present conditions, the placing of the material in drying storage is made rather awkward due to the fact that the place of storage is not convenient to the last operation in the factory before being removed. Not only this difficulty but due to the fact that all the machines were not installed at the same time - new machines being added to the plant, were placed where space permitted them to be placed and due to this fact, the material often travels in circles about one room before completing the operation. A study of the conditions is represented on an attached drawing, and an effort has been made to indicate the exact path followed by the material. These paths were

studied before placing the machinery in the new arrangement, an effort being made to decrease the length of the path of the material to the completed product.

IX. LIGHTING.

The lighting system of the plant was studied and a new system worked out, and in connection with this work, the booklet furnished by the General Electric Company on illumination, was followed. It was found that in part of the plant, marked on an accompanying drawing, the lighting was satisfactory but that in other parts, new fixtures as well as a new ceiling and lighter colored walls was necessary. The system of calculation is noted on the drawings, eight to ten foot candles being the required light according to the General Electric Company Bulletin. With the new arrangement of machines, the over head shifting

and melting could be eliminated and it is alone tends to give more satisfactory lighting as these objects tend to break up the light and destroy its uniformity.

X. CONCLUSION.

In conclusion, it might be said that no definite figures were obtained on the resulting savings due to the changes indicated by this study. However it seems apparent that they will increase production at a less cost and improve the general conditions of the factory to a large extent.

← log

Narrow Gauge Log Trk. Hot Wa

← 42' 40'

Office

Storage Material
Shed.

80'

23' Water Tank

Main Bldg.

2nd story
Passage.

Warehouse Finished Prod.
2 story. 2nd office
P.F.

80'
Road.

Lumber
Storage

st

Binding.

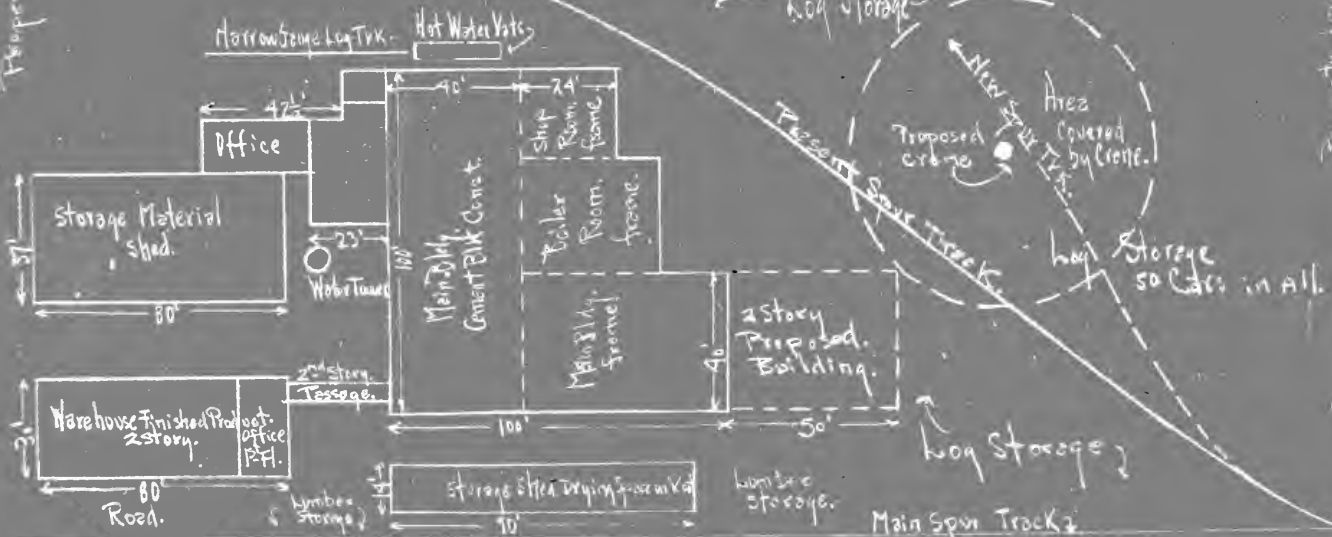
River.

Plate A
General Location Drawing
Showing Changes proposed.
Dischase.

Log Storage

Property line.

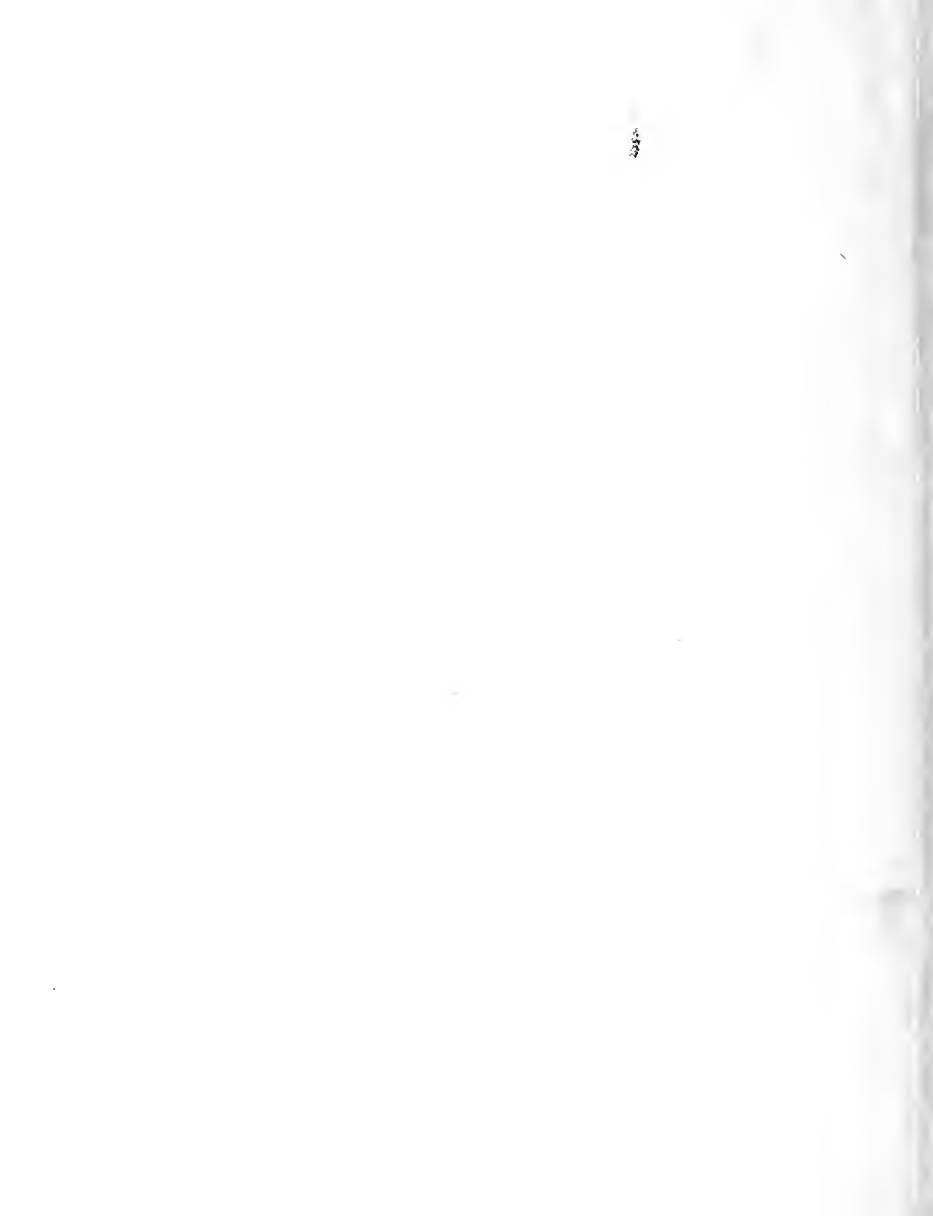
Property line.

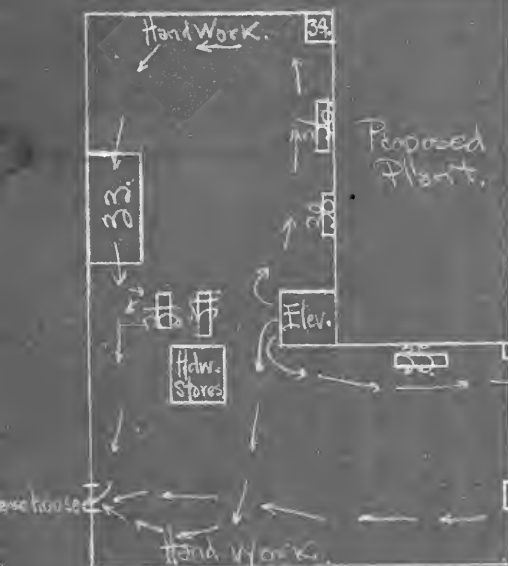


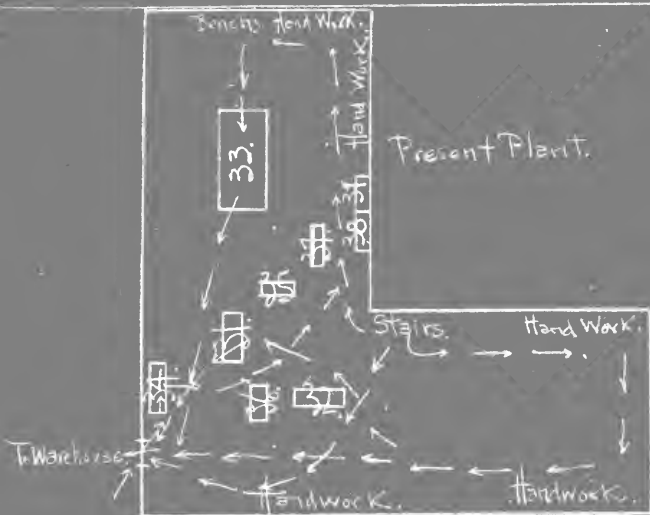










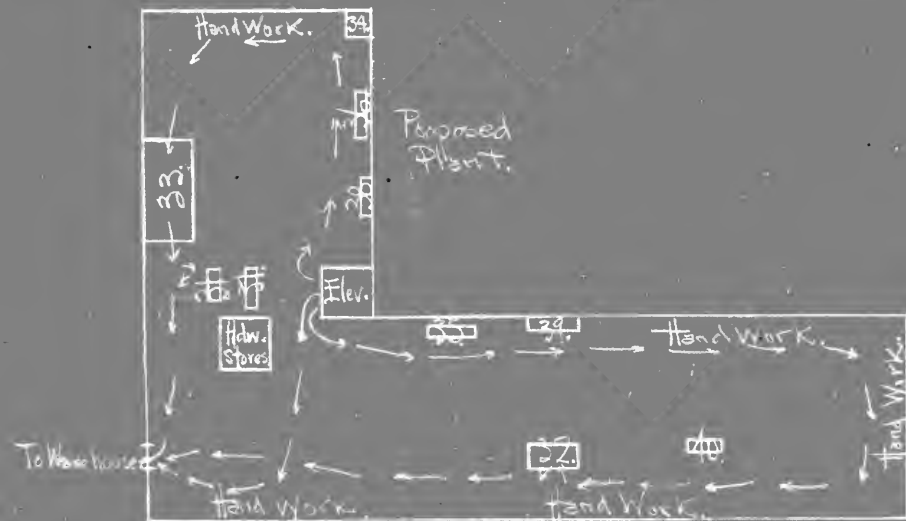


Present Plant.

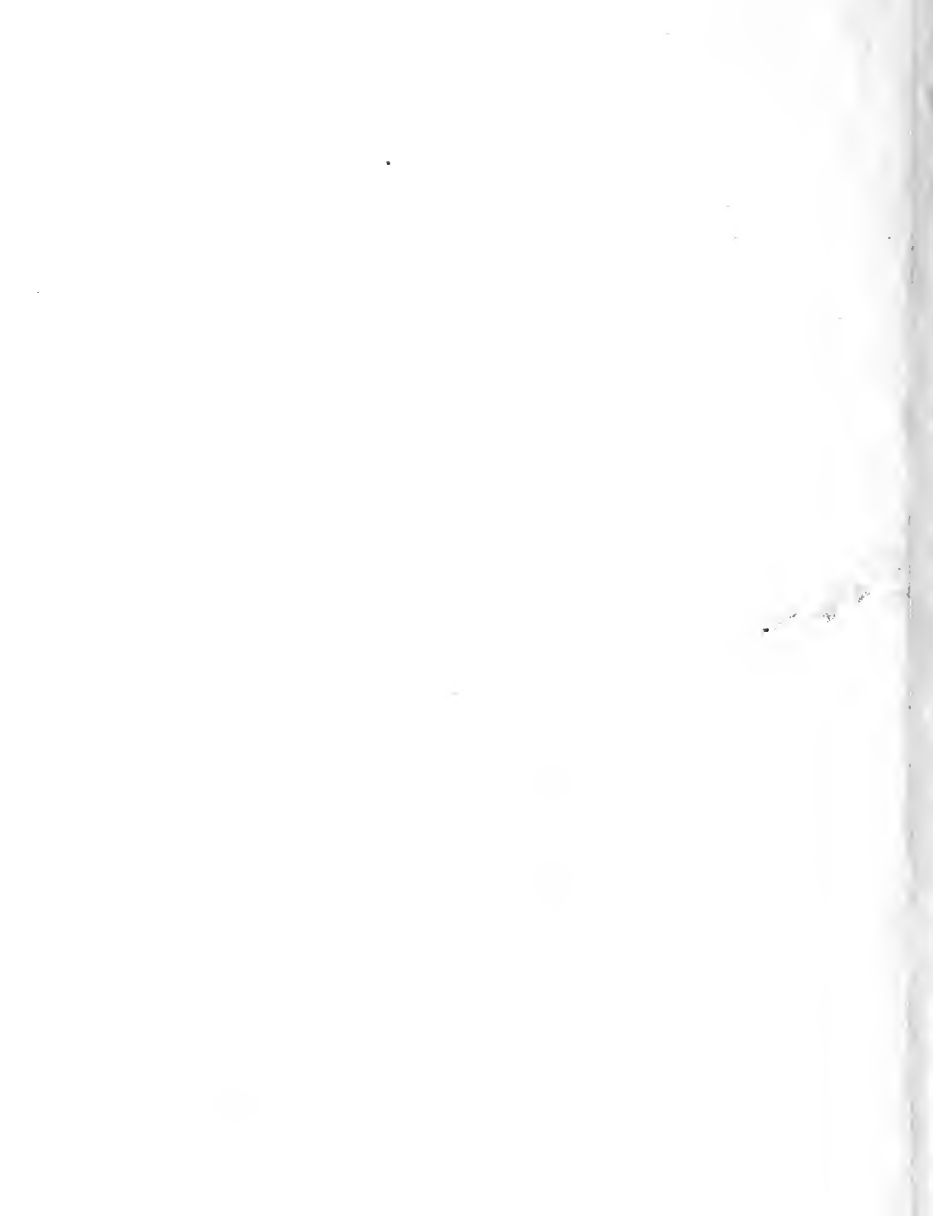
- | | | |
|----|--------------------|------|
| 31 | Rip Saw | H.P. |
| 32 | Rip Saw | |
| 33 | Drilling, Riveting | |
| 34 | Cotton Form. | |
| 35 | Steel Shears | |
| 36 | Cotton Form. | |
| 37 | Water T.K. | |
| 38 | Steam Ex. | |
| 39 | Steam Ex. | |
| 40 | Water T.K. | |

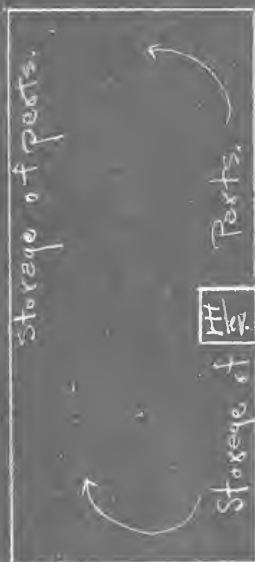
Speed.
1120
1720

Plate C.
Second Floor Plan.
Showing path of material.
Scale: 1/4" = 5'
D. S. Chase.



Proposed Plant.





Parts by
Proposed



Parts
either
are
be
Present Pl.





Parts are placed in storage either by carrying up stairs or by hand hoist. They are taken down stairs to be used.

Present Plan.



Parts would be transported by Elevator.

Proposed Plan.

Plate D.
Plan of 3rd Floor.
Scale: $\frac{1}{4}" = 5'$
D.S. Chase.



1st Floor Main Bldg.

40

[illegible]

Proposed lighting system.

lighting system

Present.

Proposed

	Present.	Proposed.
1st Floor Main Bldg.	Poor	8-10 Ft. Candles, Beaver Board Ceiling.
1st " Girls' Wk. Rm.	8-10 Ft. Cds.	Nothing.
2nd Floor Main Bldg.	Poor	New Beaver Board Ceiling will give 8-10 Ft. Cds.
2nd " Girls' Wk. Rm.	8-10 Ft. Cds.	Nothing.
Rest of lighting system	O.K.	

Calculations for System Proposed.

Required 8-10 ft. Candles From Stalls tables.

Reflection Factor 50% Ceiling & 3% for walls

Lighting Unit: 10' 1/2" above floor. Dist. between Outlets: 12" to C. + 6" from Wall.

Coef. of Utilization. 60 Tables.

Depreciation factor 1.5 tables.

Room Index = 3.0 from tables.

$$A = \frac{\text{Total Area}}{\text{No. Outlets}} = 11 \text{ sq ft./outlet.}$$

$$B = \frac{\text{Ft. Cas.} \times \text{Dep. Factor.}}{\text{Coeff. of Utiliz.}} = 20 \text{ lamp/room/sq. ft.}$$

$C = 20 \times 10^{11} = 2220$ Lamp Lumens/ortlet.

Lamp Decided upon R. M. DOME - Clear ^{Mazda C} 200 Watt lamps. Should give 10 Fcds

Eff. Illumination	Eff. Illumination	Favorable Appearance	Direct Glare	Reflected Glare	Shadows	Maintenance
A+	B+	C+	C	D	E+	A+

PLATE-E-lighting system

Scale: $\frac{1}{4}'' = 5'$
D.S. Chase.



